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(54) **Preparation of hollow plastic articles.**

(57) The present invention involves transferring plastic parisons from a receiving station to a finishing station on a plurality of pallets for forming said parisons into hollow plastic articles. The pallets with parisons thereon are preferably transported through a temperature conditioning means for temperature conditioning said parisons to render same suitable for forming into said hollow plastic articles at the finishing station.

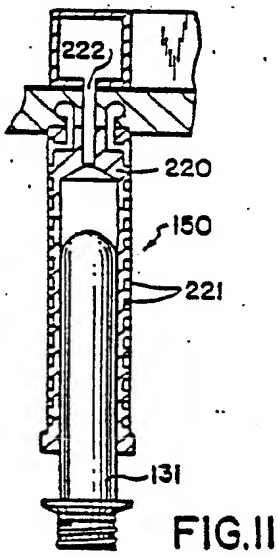

FIG.11

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PREPARATION OF HOLLOW PLASTIC ARTICLES

BACKGROUND OF THE INVENTION

Our present invention relates to a system for producing, by injection or compression molding (collectively referred to as pressure molding), partly finished workpieces which are transferred sequentially to one or more aftertreatment stations for the performance of secondary operations thereon. In particular, the workpieces may be parisons of polymeric material and the secondary operations may be thermal conditioning thereof followed by their transformation into hollow articles, such as containers, by blowing with or without mechanical stretching.

A system for conveying parisons or preforms by means of pallets into and out of a blow molding station has been described in U.S. Patent No. 4,426,202 to Krishnakumar et al. According to that patent, the parisons or preforms presumably molded at a remote location are carried in groups on rotatable collets of roller-supported pallets which move on a track to the blow molding station where each parison is introduced between two open mold halves, subsequently closing therearound for transforming same into bottles. During the blow and briefly thereafter, the parisons and the bottles formed therefrom remain attached by their necks to the collets of their pallets which, however, do not otherwise participate in the blow molding operation. On the contrary, as expressely stated in the patent, the support of the preforms, i.e. the engagement of their flanges for holding them in position, is transferred from the pallet to the blow mold during the blow operation. Nothing is said about where or how the pallets, which are separated from their track after the blow, are loaded and unloaded.

A major object of our present invention is to provide an efficiently operating system for the continuous recirculation of a sufficient number of pallets between a receiving station, at which they are to be loaded with workpieces yet to be finished, and one or more aftertreatment stations for further handling and finishing.

Another object is to provide a system of this nature in which the loading of the pallets which newly arriving workpieces, their transportation to the aftertreatment station, their handling in the latter stations and the return of the pallets to the receiving station are precisely synchronized with one another and with the source of the workpieces, e.g. an injection molding machine, to provide the desired high degree of efficiency.

It is also an object of our invention to provide an improved pallet structure for a system of this type which enables accurate location and secure retention of each parison in a finishing station, particularly in a blow molding station in which it is inflated with or without the use of a stretching rod.

A more particular object of our invention is to synchronize the operation of a premolding apparatus, specifically an injection molding machine, with those of a temperature conditioning and a blow molding station, having regard to the fact that an operating cycle of the latter station is considerably shorter than that of an injection molding machine so that the difference in timing has to be taken into account. Since the overall number of available pallets will normally be limited, out invention further aims at insuring a return of unloaded pallets to the loading point in time for having them receive the newly arriving partly finished workpieces in keeping with the cycle of the injection molding machine.

SUMMARY OF THE INVENTION

Pursuant to one aspect of our invention, a system for handling partly finished workpieces periodically arriving at a receiving station for transportation to one or more aftertreatment stations, including a finishing station, comprises presentation means at the receiving station for making the arriving workpieces available to a multiplicity of pallets successively entrainable by conveyor means from the receiving station to the finishing station. Each pallet is provided with holding means for releasably retaining a workpiece available at the presentation means and is further provided with locating means for temporarily consolidating the respective pallet with an operative part of the finishing station to insure the proper positioning of the workpiece with reference thereto. The system further includes unloading means disposed along the path of the conveyor means for removing the finished workpieces from their pallets. The unloading means could be part of the finishing station or disposed in a discharge station downstream therefrom.

In the specific instance where the workpieces are parisons previously molded in a pressure molding machine, the presentation means may comprise a take-off plate picking up a group of freshly molded parisons for delivery to a number of pallets sufficient to receive them. This will enable the pressure molding machine to operate in synchronism with the finishing station even though their cycles may be different from each other. When the finishing station comprises a blow mold, designed

to convert the parisons into end products such as containers, the loading means of the pallets may be clampingly engaged by coacting extensions of a pair of blow mold halves during a blowing operation.

Such a pallet, pursuant to another feature of our invention, comprises a body engageable by the conveyor means during transportation, either between flights mounted on the conveyor surface or with the aid of depending formations fitting between chain links of the conveyor. The holding means may comprise one or more rotatable plugs each engageable with a neck of a parison while the locating means may be formed by a socket wherein each plug is journaled for independent rotation. The plug advantageously has a central bore accommodating both a parison-inflating pressure fluid and a parison-stretching core rod at the blow molding station when the pallet is arrested there by the gripping of its socket between the mold halves.

In accordance with a more particular feature of our invention, the conveyor means may include a first branch moving from the receiving station to the finishing station and a second branch moving from the finishing station to the receiving station, the two branches being interlinked by first transfer means synchronized therewith for moving the pallets from a downstream part of the second branch to an upstream part of the first branch by way of the receiving station, with loading of each passing pallet at the receiving station by at least one newly arrived workpiece, and by second transfer means synchronized therewith for moving the pallets from a downstream part of the first branch to an upstream part of the second branch by way of the finishing station, with unloading of each passing pallet ahead of the second branch.

It is often desirable to let the freshly molded parisons, still hot except at their neck, traverse a tempering chamber on their way to the blow molding station, i.e. while being entrained by the first conveyor branch. Such a tempering chamber, constituting another aftertreatment station preceding the finishing station, is designed to minimize the loss of heat stored in the body of each parison and, if necessary, to redistribute the heat profile of that body in a manner suitable for the blowing step. Thus, the chamber may be provided with heating and/or cooling means to which each parison ought to be uniformly exposed around its entire periphery. The plugs, therefore, advantageously are rotatably journaled in their pallets and are engageable by drive means for setting them together with their parisons in rotation for such uniform exposure.

If the parisons are produced by an injection molding machine whose operating cycle lasts n times as long as that of the blow molding or other finishing station, each injection cycle ought to produce n times as many parisons as can be handled in a single finishing cycle. The latter number preferably equals the number of parisons transportable by one pallet so that n pallets should be loaded simultaneously at the receiving station but are to be successively moved into the finishing station. Preferably, an ejection or discharge station immediately following the last aftertreatment, e.g. the blowing station, is used for the unloading of each pallet with the aid of air, some other fluid under pressure or suction, or mechanical means introduced from below into the parison necks so as to dislodge the end products from the pallets. These end products could also be removed from the pallets directly at the last aftertreatment station, if desired.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features of out invention will now be described in detail with reference to the accompanying drawings in which:

Fig. 1 is a top view of a transportation system according to our invention, serving for the conveyance of freshly molded parisons available at a receiving station to a tempering chamber and then to a blow molding station by means of pallets and for the returen of the empty pallets to the receiving station;

Fig. 2 is a cross-sectional view of the system, taken on the line II-II of Fig. 1;

Fig. 3 is a side-elevational view, partly in section and drawn to a larger scale, of a pallet carrying two parisons about to be finished in the blow molding station;

Fig. 4 is a side elevational view of an alternate type of conveyor usable in out present system;

Fig. 5 is a fragmentary end view, partly in section, of the conveyor shown in Fig. 4;

Fig. 6 is a perspective view of a preferred embodiment of the apparatus of the present invention;

Fig. 6A is a top view of a preferred embodiment of the apparatus of the present invention;

Fig. 7 is a cross-sectional view along the lines 7-7 of Fig. 6A;

Fig. 8 is a cross-sectional view along the lines 8-8 of Fig. 6A;

Fig. 8A is a perspective view of the pusher means shown in Fig. 8;

Fig. 9 is a cross-sectional view along the lines 9-9 of Fig. 6A;

Fig. 10 is an isometric view of the finishing station shown in Fig. 6A;

Fig. 10A is a schematic view of the finishing station;

Fig. 10B is a perspective view of the engaging means for moving the pallets into the finishing station and out of the finishing station;

Fig. 11 is a detailed view of the carrying means for conveying the parisons from the injection mold to the receiving station at one point in the operation; and

Fig. 12 is a detailed view of the same carrying means for conveying the parisons from the injection mold to the receiving station at a later stage in the operation.

DETAILED DESCRIPTION

The system for the production, transportation and finishing of parisons shown in Figs. 1 and 2 as a representative embodiment of our invention includes transportation means constituted by two parallel conveyor branches 11, 12 and transfer paths 13 and 14 perpendicular thereto. Each conveyor branch 11, 12 comprises an endless belt 15 provided with equispaced flights 16 as best illustrated for branch 11 in Fig. 2. As also illustrated for branch 11 in Fig. 2, the belt 15 is wound about an upstream sprocket 17 and a downstream sprocket 18 carried by shafts 19 and 20. Other shafts 21 and 22 are respectively keyed to an upstream sprocket and a downstream sprocket of branch 12, at least one shaft of each branch being coupled with a non-illustrated intermittently operating drive displacing their belts in mutual synchromism but in opposite directions. Thus, the upper run of belt 15 of branch 11 moves from left to right, as viewed in Figs. 1 and 2, while the corresponding run of the other branch moves from right to left.

The beveled flights 16 of each band are designed to accommodate respective pallets 23 fitting closely into the intervening spaces. Each pallet, as more fully described hereinafter with reference to Fig. 3, is provided with one or more (here two) upstanding plugs 24 designed to receive parisons 25 which are produced in an injection molding machine (not shown) mounted at an elevated level above transfer path 13. That machine produces, during each of its operating cycles, a multiplicity of parisons 25 (here eight), to be received by a suitable number of pallets, which are extracted from between its mold portions by a take-off plate 26 as described, for example, in commonly owned U.S. Patnet No. 3,454,991. In its original retrieval position, plate 26 confronts four rows of two cores each on one of the spaced-apart mold portions on which respective parisons 25 have been formed; plate 26 has eight seats in which the closed ends of these parisons are held under suction applied via a tube 27. After the plate 26 with its eight parisons has been extracted from the injection mold, it is swung about a shaft 28 into the horizontal presentation position shown in Fig. 2 in which the parisons are vertical with neck portions 29 hanging down.

Transfer path 13 comprises a stationary platform 30 and an elevatable platform 31 in series with each other, platform 31 and take-off plate 26 together consituting a receiving station. Each of these platforms is of rectangular outline and of a width (in the direction transverse to the conveyor motion) sufficient to accommodate the length of a pallet. A set of five flights 32, 33 on these platforms, of the same profile as the conveyor flights 16, are aligned with one another and with respective flights 16 at a particular instant when branches 11 and 12 are briefly halted; the aligned flights define four parallel tracks. At such an instant a 4-pronged pusher 34 is thrust into the last pallet containing interflight gaps of branch 12 to move the pallets thereof into corresponding gaps of platform 30 while dislodging the pallets previously seated therein into aligned gaps of platform 31 which in that part of a cycle is coplanar with platform 30 and the upper runs of branches 11, 12. Alternate ways to engage pallets 23 with the conveyor branches, which do not require halting same for loading, are available as discussed hereinafter with reference to Figs. 4 and 5 and are usable in the system of our present invention. Platform 31, mounted atop a vertically reciprocable piston rod 35 of an otherwise non-illustrated fluidic jack, is then raised to an elevated level (Fig. 2) so that the four empty pallets now present thereon approach the take-off plate 26 horizontally overlying same at this moment. The plugs 24 of the four pallets thereupon engage the necks of the parisons depending from plate 26 wile the suction retaining the parisons on that plate is released. Upon the immediately following descent of the platform 31 with its loaded pallets, the latter are aligned with four empty gaps of branch 11 which has advanced by four stages since the last four pallets were received thereon from platform 31 by the aforedescribed thrust of pusher 34. The same four steps have also brought a new set of pallets on branch 12 into line with platforms 30 and 31 so that a new thrust of pusher 34 will shift the pallet sets from branch 12, platform 30 and platform 31 to platform 30, platform 31 and branch 11, respectively. Meanwhile, another injection molding cycle has been completed and take-off plate 26 has been reinserted between the reopened mold portions to pick up a new set of parisons 25 even as the pallets carrying the previously extracted

parisons are advanced by conveyor branch 11 to the right as viewed in Figs. 1 and 2. A ledge 36 at the far edge of branch 11 prevents the oncoming pallets from overshooting the conveyor band.

As seen in Fig. 1 the pallets each have a longitudinal axis perpendicular to the direction of conveyor motion. Naturally, we could readily align the pallets so that they will be carried by the conveyor with their longitudinal axis parallel to the direction of travel, e.g. to transport a single row of preforms.

The plugs 24, which are rotatably journaled in their pallets as more fully described hereinafter with reference to Fig. 3, carry pulleys 37 which are accessible from opposite ends of each pallet for engagement by a pair of endless belts 38, 39 disposed underneath a tempering chamber 40 overlying the conveyor branch 11. Chamber 40 has an at least partly open entrance end admitting the two rows of parisons entrained by that branch. Only the portions of the parisons that are to be heat treated, however, pass through the chamber while the ones that are not to be tempered, e.g. the necks 29, project through bottom slots of the chamber so as to be continuously exposed to the atmosphere. A frame 41 supporting the chamber 40 carries a driving unit 42 which rotates two sets of pulleys 43, 44 embraced by the belts 38 und 39. Through their fricitional contact with pulleys 37, these belts turn each parison about its own vertical axis as it passes through chamber 40. It should be noted that, during such passage and thereafter, the pallets are guided by the aforementioned ledge 36 and by another, shorter ledge 45 extending along the opposite edge of branch 11.

Tempering chamber 40 may contain heating and/or cooling elements, not shown, to whicht he continuously rotating parisons 25 are uniformly exposed.

In contradistinction to transfer path 13 with its four parallel tracks, transfer path 14 has only a singly track which passes through a finishing station, in this instance a blowing station 46, and an ejection station 47. Each of these stations has a length substantially equal to that of a pallet. With the conveyor bands temporarily halted, the last pallet to arrive at the downstream end (right) of branch 11 is thrust by a pusher 48 into blowing station 46 while the pallet previously located there, carrying finished products 25' resulting from the blowing of its parisons, is advanced by the same motion into the ejection station 47 where these finished products, i.e. bottles, are discharged by air pressure as seen in Fig. 2. Alternatively, suction from above could be used for extraction of the products. The pallet previously unloaded in station 47 by this procedure is concurrently shoved into an aligned interflight gap of conveyor branch 12 for return to the downstream end of this branch and recirculation over transfer path 13 with the aid of pusher 34.

Station 46 comprises a blow mold which may be of single-piece construction or, as here shown, composed of two blow mold haves 46a, 46b which are separable by associated jacks 48a, 48b to make room for a new parison loaded pallet while letting the pallet carrying previously formed bottles leave the blow mold. As seen in Fig. 2, the pallets traveling on transfer path 14 are guided by a throughgoing rail 49 centered with reference to stations 46 and 47. In principle, however, it is also possible to hold one blow mold half (e.g. 46a) stationary, at a location withdrawn from that shown in the drawing, and to reciprocate the other half with reference thereto between an open and a closed position, a section of rail 49 being transversely shiftable to let the pallet present in that station move concurrently with the reciprocable mold half (46b) to bring its parisons into the cavities of the stationary half before the blow and thereafter withdraw the final products during the mold opening stroke to restore the continuity of that rail 49.

Ejection station 47 comprises two discharge tubes 47a, 47b positioned to overlie the two freshly blown bottles on an incoming pallet. Two conduits 50 (only one shown) pass through the rail 49 to the underside of the pallet so as to be respectively aligned with its necks 24 when the pallet comes to rest in station 47. Air under pressure flowing through these conduits lifts the bottles off these necks and drives them through the tubes 47a, 47b into a non-illustrated receptacle or onto an ancillary conveyor.

Pushers 34 and 48 must, of course, be properly synchronized with the stepping motion of the conveyor branches for satisfactory operation of the system as described above.

Reference will now be made to Fig. 3 for a more detailed description of a representative pallet 23. The pallet body carries a pair of brackets 51a, 51b with flanges spacedly overhanging its rectangular base. Plugs 24, serving as holding means respectively engaging two parisons 25a, 25b, have stems jounaled by means of ball bearings 52 in sockets 57a, 57b and carry pulleys 37a, 37b, as described above, on their lower extremities. The stems are hollow and, in the blowing station 46, are penetrated by core rods 53a and 53b capable of being thrust up to stretch the parisons axially prior to the admission of fluid pressure thereinto. There is sufficient clearance around these rods to let air under pressure flow into the parisons to expand same against the walls of the corresponding mold cavities as indicated at 25a' for parison 25a. Holes

54 in the pallet, traversed by the stretching rods and the air blasts in station 46, may serve in station 47 for the admission of the ejection air. To align the parison with the cavity formed by the blow mold halves 46a and 46b in the closed position and to assure that the axes of the parison and the cavity coincide with sufficient accuracy for the production of bottles with negligible circumferential wall thickness variation, sockets 57a and 57b serving as locators are accurately spaced and machined, and the blow mold halves contain equally accurate cavity extensions 58. Upon closure of the blow mold, plugs 24 and the pallets carrying them thus effectively form part of the blow mold.

Upon returning from transfer path 14 to transfer path 13 on the reverse branch 12, the pallets 23 are also guided between a pair of stationary ledges 55, 56 as seen in Fig. 1.

In Figs. 4 and 5 we have schematically illustrated the possibility of using several sequential chain pairs 61, 62 63 in lieu of the throughgoing conveyor band of, say, branch 11. The chains of each pair are driven by respective sprocket wheels 64 keyed to a shaft 60 coupled with a non-illustrated motor. Each chain is divided into two halves, indicated at 61′ and 61″ in Fig. 5, respectively passing around an outer half and an inner half of the associated sprocket. One sprocket half carries teeth 65 engaging in the meshes of the corresponding chain half 61′. Similar but oppositely facig teeth 66 depend from the base of a pallet 23′ to be entrained, these latter teeth penetrating into the meshes of the other chain half. Pallets 23′, with plugs 24′ and pulleys 37′, are generally similar to those described above and are guided between ledges 36′, 45′ while riding on shelves 67, 68 flanking the chains.

In this instance, the pallets cannot be transversely loaded onto and unloaded from the conveyors. Thus, a set of four pallets to be entrained by the cascaded chain pairs 61 - 63 through the tempering chamber 40 and toward the finishing station 46 and the ejector station 47 of Figs. 1 and 2 will have to be deposited first on a table 69 interconnecting the shelves 67 and 68 ahead of the first chain pair 61 on which these pallets are then thrust by a non-illustrated pusher into engagement with chain pair 61. At the end of this chain pair, the pallets are pushed over an intervening portion of shelves 67, 68 onto chain pair 62 and from there in an analogous manner onto chain pair 63 which discharges them onto a table 70 for further transportation through the finishing station. The middle pair of chains 62 may be used to convey the pallets through the tempering chamber 40 of Figs. 1 and 2.

With such sequential conveyors it is possible to drive the several chain pairs 61, 62 and 63 at different speeds for optimal exposure of the parisons to the several work stations and to different zone locations within the tempering chamber, with the pallets spaced apart on each chain pair according to its velocity. Typically, the tempering chamber is divided into several such zones, each imparting a different temperature to the parisons, depending on the temperature of the heating or cooling means within each zone and the time of exposure of the parisons thereto. In order to control the effect of these zones upon the parisons, not only their temperature may be varied, as is conventionally done, but also the time of exposure which in many instances is more reliable as a method of control.

In a preferred embodiment of the present invention shown in Figs. 6 and 6A, first conveyor means 110 transports pallets 111 from receiving station 112 to finishing station 113. The empty pallets are returned to the receiving station 112 via second conveyor means 114. Thus, as seen in Fig. 6A the first conveyor means moves from left to right and the second conveyor means moves from right to left. The conveyor means preferably comprises a continuous chain or belt as shown, although separate, synchronized chain sections may be used. Sprockets 115, 116 and 117 are shown engaging chain links 118 of the conveyor means for moving same in a rotary direction, see Figs. 8 and 9. Thus, as shown in Fig. 6A, sprockets 115 and 116 move counterclockwise and sprocket 117 moves clockwise so that the chain links and hence the conveyor means are transported in a desired direction. Any desired motive means may be utilized to power any one or more of the sprockets so that, for example, one sprocket may be powered and the others may freely rotate. Chain guides 119 are provided around chain links 118 in order to guide same in their path. Means are provided associated with the conveyor means and engageable with the pallets for pushing the pallets along the conveyor means, such as pusher means 120 connected to chain links 118 which engage the base of pallets 111 in order to push the pallets along their path. These can be clearly seen in Fig. 9.

The pallets 111 contain a desired number of parison holding means or plugs 130 for holding parisons 131 via the open neck thereof 132, with three such plugs per pallet shown in the drawings. Pallets 111 comprise a platform member 133 supporting parison holding means or plugs 130 which are rotatably journaled to pulley means 134 beneath platform member 133 so that the pulley means 134 and hence the plugs may be rotated in a clockwise or counterclockwise direction as desired. Any number of parison holding means of

plugs 130 may be selected for each pallet. Generally, the number of plugs per pallet will correspond to the number of blow molds at the finished station to be described hereinbelow. Pallets 111 are guided by channel track 135 as they move on the conveyor means.

The parisons are preferably delivered to the receiving station as the output of an associated injection molding machine, although other parison preparation or delivery means may be used, for example, compression or extrusion molding. In the preferred embodiment as shown in Figs. 6 and 6A, injection molding machine 140 prepares the appropriate number or parisons based on the capacity of the injection molding machine. Naturally, any desired injection molding configuration may be used. As shown in Figs. 6 and 6A, the injection molding machine includes a fixed platen 141 and a movable plåten 142. The movalbe platen moves on tie rods 143 via machine clamp 144. Mold means 145 are provided between the fixed and movable platen to prepare the desired number of parisons. Carrier means such as robot 146 are provided adjacent the fixed and movable platen having track 147 for carrying robot arm 148 (see Fig. 7) which in turn carries robot plate 149. Robot plate contains adjacent thereto a number of parison carrying means 150 corresponding to the number of parisons prepared in the injection molding machine. Carrying means 150 are open ended hollow tubes having channel means 151 at the base thereof connected to vacuum or suction means 152 for holding the parisons in the tubes. Thus, parisons are formed in injection molding machine 140, movalbe platen 142 disengages from the fixed platen 141 and robot arm 148 carrying robot plate 149 moves between the fixed and movable platen so that parison carrying means or tubes 150 engage parisons 131. Suction means 152 is used to transfer parisons 131 from the injection molding machine to tubes 150 and retain the parisons therein. Robot plate 149 is then moved out from between fixed platen 141 and movable platen 142 and rotated so that robot plate 149 is placed adjacent receiving station 112 as shown in Fig. 7. Parisons 131 are then delivered to pallets 111 by releasing the suction from suction means 152. Parisons 131 are then relased so that the open neck portion 132 engages plugs 130 with guide tube 160 supported by support frame 161 insuring that the parisons are properly directed to engage plugs 130. Referring to Fig. 7, it can be seen that the parisons 131 are properly seated on plugs 130. As shown in phantom in Fig. 7, open neck 132 indicates the position of the parison in tubes 150.

After the parisons are loaded on pallets 111 the pallets are transferred one at a time from the receiving station to the first conveyor means 111. Simultaneously therewith, an empty pallet is transferred from the second conveyor means to the receiving station. This operation can be seen in Figs. 8 and 8A wherein pusher means 162 is provided above the level of the pallets having a pusher frame 163 and pusher rods 164 journaled therein. Pusher frame 163 carries forward pusher arms 165 and rearward pusher arms 166. The forward pusher arms 165 engage the pallet adjacent the first conveyor means and the rearward pusher arms 166 engage the pallet on the second conveyor means. Upon activation of pusher 162 pusher arms 165 and 166 cooperate to move the pallet adjacent the first conveyor means from the receiving station to the first conveyor means and the pallet from the second conveyor means to the receiving station. This operation is continued until the pallets with parisons thereon are moved one at a time from the receiving station to the first conveyor means and until empty pallets from the second conveyor means are moved to the receiving station so that the receiving station contains a series of empty pallets corresponding to the product output of the injection molding machine. The parisons are then transferred from the injection molding machine to the empty pallets at the receiving station as described hereinabove.

As indicated hereinabove, the initial step of the temperature conditioning cycle for conditioning the parisons from the injection molding machine to the finishing station is the post cooling operation conducted in the parison carrying means or tubes 150. Preferably, the parison carrying means or tubes are provided with heat transfer means which will be described in more detail hereinbelow in order to post cool the still warm parisons from the injection molding operation.

The parisons are then transported from the receiving station 112 to the finishing station 113 on first conveyor means 110. A temperature conditioning means 170 is provided adjacent the first conveyor means 110 so that parisons 131 can have their temperature properly conditioned on their path from the receiving station to the finishing station. The purpose of the temperature conditioning means is to condition the temperature of the parison to render same suitable for forming into hollow plastic articles at the finishing station. The features of the preferred temperature conditioning means can be clearly seen in Fig. 9. The plastic parisons 131 on pallets 111 pass through temperature conditioning means 170 in a single row. The temperature conditioning means first equalizes the temperature of the parisons and second obtains the desired temperature profile for forming said par-

isons into hollow plastic articles. Fig. 9 shows conditioning tunnel 171 surrounding parisons 131 and containing temperature conditioning means 172 adjacent parisons 131. A plurality of such temperature conditioning means 172 are provided along the length of the parisons in order to provide the exact temperature profile needed by the parison in the finishing operation. The temperature conditioning means may be radiant or air jets and these may also be used to first equalize the temperature of the parisons. The parisons arrive at the first conveyor means with an unequal distribution of temperature between the inside and outside thereof. Thus, it is the first stage of the temperature conditioning means to equalize the temperature between the inside and outside thereof by means of temperature conditioning means 172 or if desired simply air jets in the initial stage of the conditioning tunnel 171. After the temperature of the parison has been equalized, a plurality of temperature conditioning means 172 may be provided adjacent various points along the length of the parison in order to provide the exact temperature distribution desired for the particular plastic and particular bottle configuration. One can very accurately control the temperature equalization and temperature profiling operation by controlling the length of the conditioning tunnel and the temperature conditioning means, and this despite the fact the individual pallets remain in the tunnel for different periods of time. Protective cover 173 is provided to protect the open neck portion 132 of the parisons so that the open neck portion is not subjected to the temperature equalization step. Safety cover 174 may be provided on the return flight in order to protect the empty pallets. If one desires to rotate the parisons during their passage through the temperature conditioning tunnel, stationary belt 175 or other means may be provided adjacent and in contacting relationship with pulley means 134 thus rotating the pulleys and hence the parisons. The speed of movement of the pallet, the diameter of the pulley and/or whether or not belt 175 is stationary or movable.

At the downstream end of the first conveyor means chain links 118 of the continuous chain pass around idler roll 180 and downstream sprocket 117 and idler roll 181 to start the return flight along second conveyor means 114.

Referring now to Figs. 10, 10A and 10B, pallets 111 are retained in channel track 135 free from chain links 118 adjacent finishing station 113 carrying parisons 131 on plugs 130 ready for the finishing operation. Finishing station 113 as shown in Fig. 10 includes fixed platen 182 and movable platen 183 with blow mold 184 therebetween containing a mold 185 in the shape of the bottle to be formed. Movable platen 183 moves on tie rods 186 activated by motor 187. Optional base mold 188 is held by support 188a and is positioned above mold 185 to form the bottle bottom with piston 189 connected thereto for moving the bottom mold into appropriate alignment for formation of the desired base for the bottle and motive means, not shown, connected thereto for activating said piston. Linkage means 190 and 191 are provided connected to the movable platen 183 and bottom mold 188, respectively, in order to maintain the desired positioning thereof. Channel track 192 slides on tie rods 186 and sits spaced from but closely adjacent to channel track 135 being moved by top and bottom linkage means 190 and 191. For better clarity of the drawings, only bottom linkage means 190 is shown in Fig. 10. Engaging means 193 shown in Figs. 6A and 10B comprises a piston 194 having a piston arm 195 with a first engaging lug 196 engaging a groove 197 in an upstream pallet 111 and a second engaging lug 198 engaging a similar groove 197 in a downstream pallet 111. First engaging lug 196 and second engaging lug 198 are rotatable in the direction of the arrow to engage and disengage grooves 197. Thus, in operation first and second engaging lugs 196 and 198 are rotated to engage grooves 197 on a pallet 111 sitting outside finishing station 113 and a pallet sitting inside finishing station 113, respectively. The piston arm 195 then moves forward to move the pallet inside the finishing station with blown bottles therein to a position outside the finishing station 113 and move a second pallet from a position outside the finishing station to a position inside the finishing station. Second piston 199 is now operated to rotate the first and second engaging lugs 196 and 198, respectively, to disengage grooves 197 and the piston arm is retracted to engage a further set of pallets for repeat of the cycle. Movable platen 183 is closed. Bottom mold 188 is moved into position via piston 189 and the blowing operation commenced. As shown specifically in Fig. 10A, a space 200 is provided to permit air to be inserted inside the parison although any other suitable means may be used for this purpose. If desired, a plug 201 can have a stretch rod associated therewith to axially stretch the parison in order to provide an oriented article and the parison is blown to its full shape as shown in Fig. 10A. When the blow mold is opened channel track 192 moves a desired distance guided by linkage means 190 in order to move the final blown article 202 the desired distance and free it from the mold 185. The pallet 111 with finished articles thereon is then moved from the finishing station to a point past or downstream of the finishing station. Pusher means 212 is located downstream of the finishing station connected to piston 213 which may be connected to any desired motive means. Track 214 engages di-

scharge station 210 with returen station 215. Thus, in operation piston 213 positions the pallet 111 containing blown articles 202 via pusher means 212 along tracks 214 to return station 215. At return station 215 the empty pallets are moved to the second conveyor means via second engaging means 216 which corresponds to engaging means 193. Located at return station 215 is discharge station 210 used to remove finished articles 202 from pallets 111 via for example a suction tube 211 or any desired means. The empty pallets are then transferred to the second conveyor means at a rate exactly corresponding to the movement of the pallets in the first conveyor means and in the finishing station. Although a particular engaging means has been shown, naturally any engaging means may be used to move the pallets in and out of the finishing station, and to move the empty pallets to the second conveyor means.

If desired the process and apparatus of the present invention may be conveniently employed to prepare multi-layered hollow plastic articles by applying a sleeve member either inside preform 131 or outside preform 131, with the compositie preform consisting of preform 131 and sleeve member heated in temperature conditioning means 170 and blown together. For example, a sleeve or liner member may be applied to plugs 130 on their return flight on second conveyor means 114. Thus, pallets 111 return to receiving station 112 containing sleeve member thereon so that preform 131 is applied ober the sleeve member and the composite conditioned and blown together at finishing station 113. Alternatively, a sleeve member may be applied on the outside of preform 131 downstream of receiving station 112 but before temperature conditioning means 170 so that the composite preform and sleeve member are conditioned together in the temperature conditioning means 170 and blown together at the finishing station 113. The resultant multi-layered article is characterized by properties of both materials, that is, the sleeve and preform, so that one can design a finished article having a desirable combination of properties not possible in a single layered material.

Referring now to Figs. 11 and 12, there show a preferred form of parison carrying means. In past practice, the parisons were stripped into a guide tube the inside dimensions of which was typically larger than that of the parisons. The parisons were then supported on the shoulder of the guide tubes by suction within the guide tubes. Upon insertion of the parison into the guide tube internal pressure was applied within the guide tube causing the still pliable parison to expand against the walls of the guide tube and thereby establishing heat transfer contact in order to obtain cooling of the parison. A pressure differential between the inside of the parison and the space between the outside thereof and the guide tube can be established by applying higher than atmospheric pressure inside the guide tube or by applying vacuum therein. Naturally, this type of system can be readily used in combination with the present invention. However, it has been found that this type of system is not entirely successful since it is difficult to carry out and necessitates accurate and expensive locating means to place the parisons into the guide tubes.

According to a preferred practice of the present invention, carrying tube 150 is provided with a cavity 222 having tapered walls as, for example, a taper of 0 degrees, 25 minutes, 30 seconds, the taper thereof being the same as the taper of the parison. Parisons are normally tapered in order to facilitate removal from the injection mold. The mouth dimension of carrying tube 150 is chosen so as not to permit the parison to fill cavity 220 completely. Instead, at the time of insertion, a small portion of the parison will protrude from carrying tube 150. Carrying tube 150 is provided with temperature control means schematically indicated by channels 221 which can be connected to any source of heat transfer fluid. Suction channel 222 is provided for removal of air from cavity 220 during insertion of the parison and is used to apply vacuum within cavity 220. It is seen that parison 131 will make contact with the inner mold wall due to the taper but only to the extent that the opening of the guide tube will permit. As the parison 131 cools in contact with the guide tube wall due to the pressure differential established between the atmosphere inside the parison and the vacuum applied through channel 222, it is reduced in size and therefore slides downward along the tapered wall of the guide tube. Fig. 12 is a schematic sectional view which shown the parison in its final position. Thus, it can be seen that the cooling effect due to surface contact between the parison and the guide tube is in this instance given by a taper which, of course, is also an automatic locating means for centering the parison in the cavity. Accordingly, in this improved post cooling mold, there is no need for expensive locating devices in the cooling process. It is automatically accomplished by virtue of the dimensional change which occurs in the parison in the course of cooling.

This invention may be embodied in other forms or carried out in other ways without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered as in all respects illustrative and not restrictive, the scope of the invention being indicated by the appended claims, and all changes which come within the meaning and range of equivalency are intended to be embraced therein.

Claims

1. A carrying means for holding and cooling an elevated temperature parison therein having an open forward end for receiving said parison, a closed rearward end, a longitudinal wall between the forward and rearward ends with an internal suface tapering inwardly towards the closed end, cooling means adjacent the longitudinal surface, wherein the elevated temperature parison has a corresponding taper but is somewhat larger than the tube so that said cooling means is operative to shrink the parison (131) upojn cooling with the parison sliding inside the tube to fit snugly therein.

2. A carrying means according to claim 1 including means for maintaining the cooled parison inside the tube.

3. A carrying means according to claim 2 wherein said means is suction means adjacent the closed end.

4. A carrying means for holding and cooling a heated parison therein, said carrying means having an open forward end for receiving said parison, a closed rearward end, a longitudinal wall between the forward and the rearward ends with an internal surface tapering inwardly towards the closed end, cooling means adjacent the longitudinal surface, whereby the internal surface is smaller than said heated parison, said parison also having a corresponding taper so that said cooling means is operative to shrink the parison upon cooling with the parison sliding inside the tube to fit snugly therein, said carrying means further including suction means adjacent the closed end for maintaining the cooled parison inside the tube.

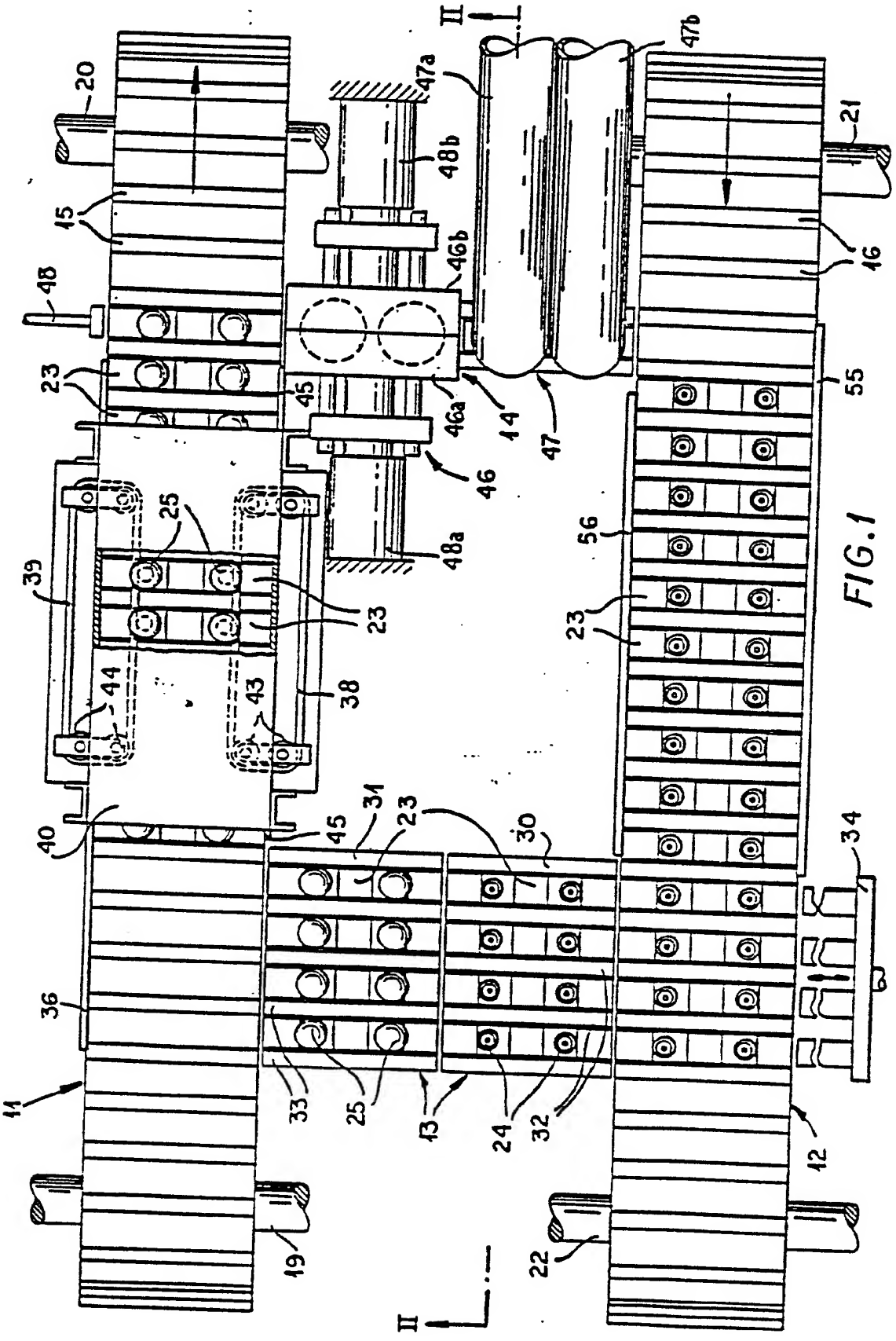
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FIG.1

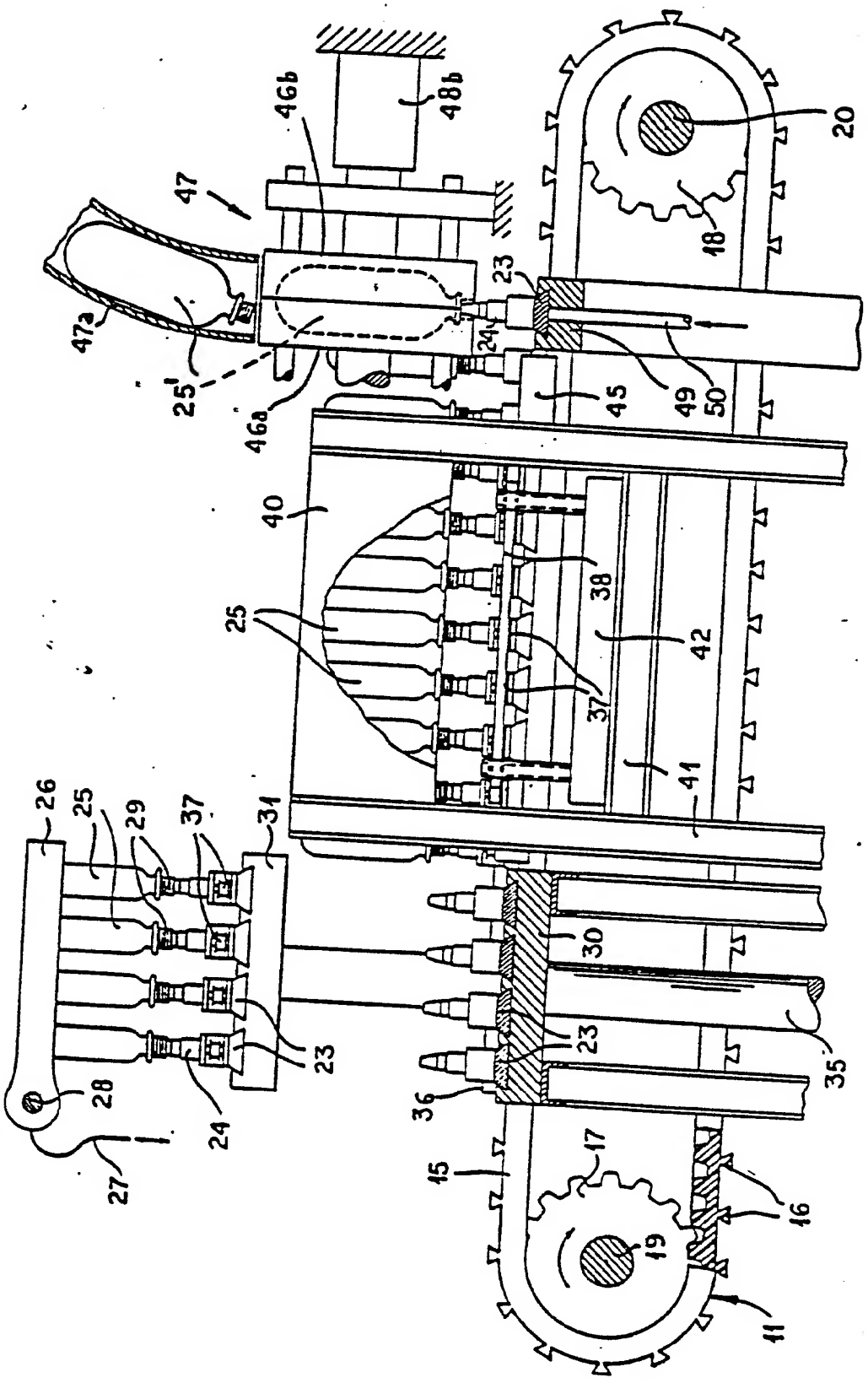
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FIG.2

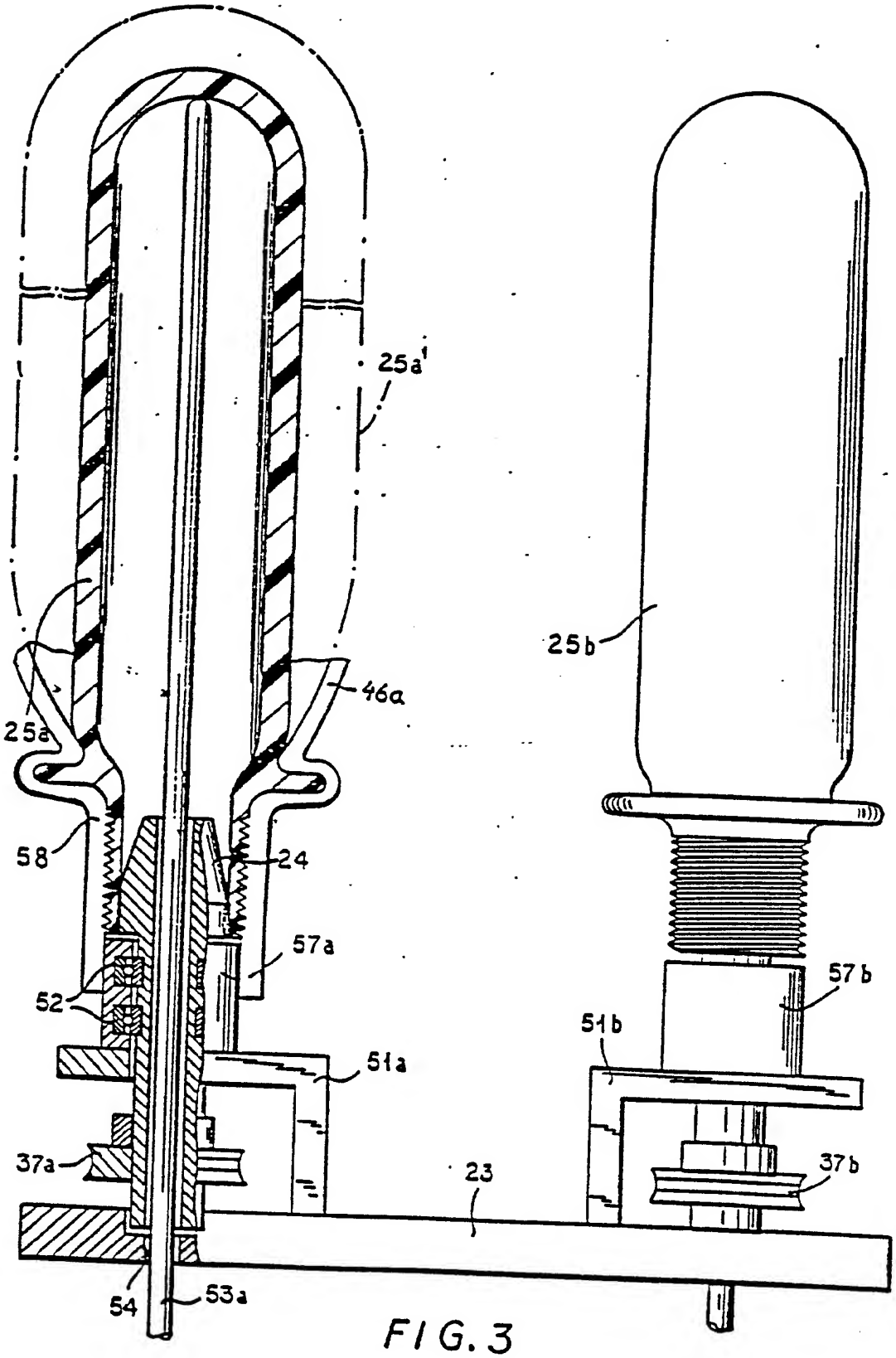

FIG. 3

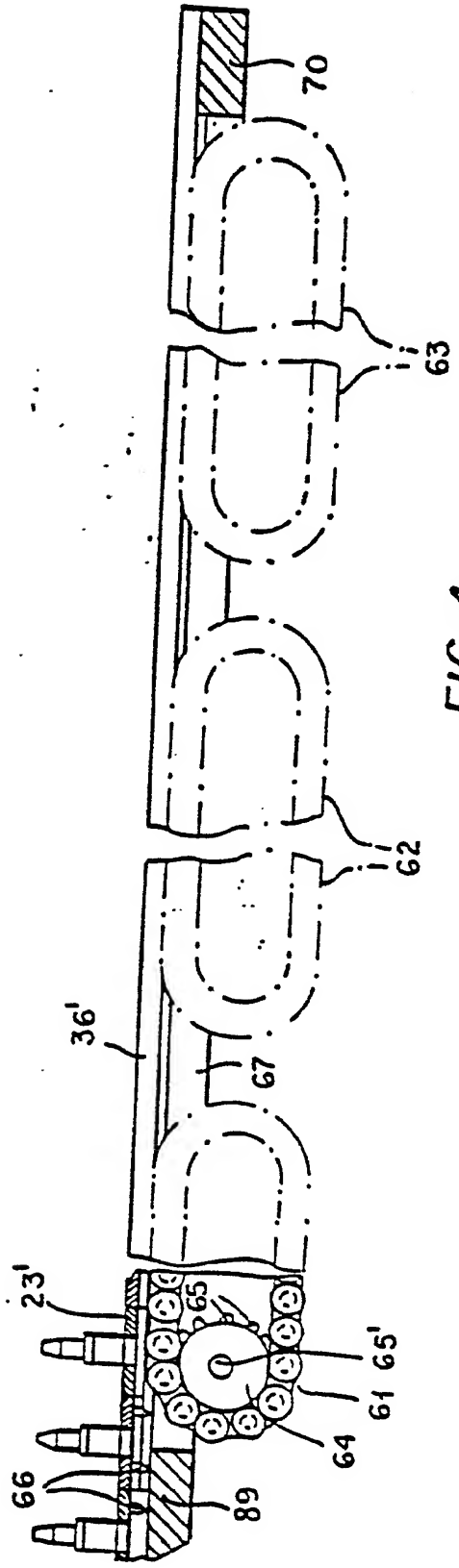

FIG. 4

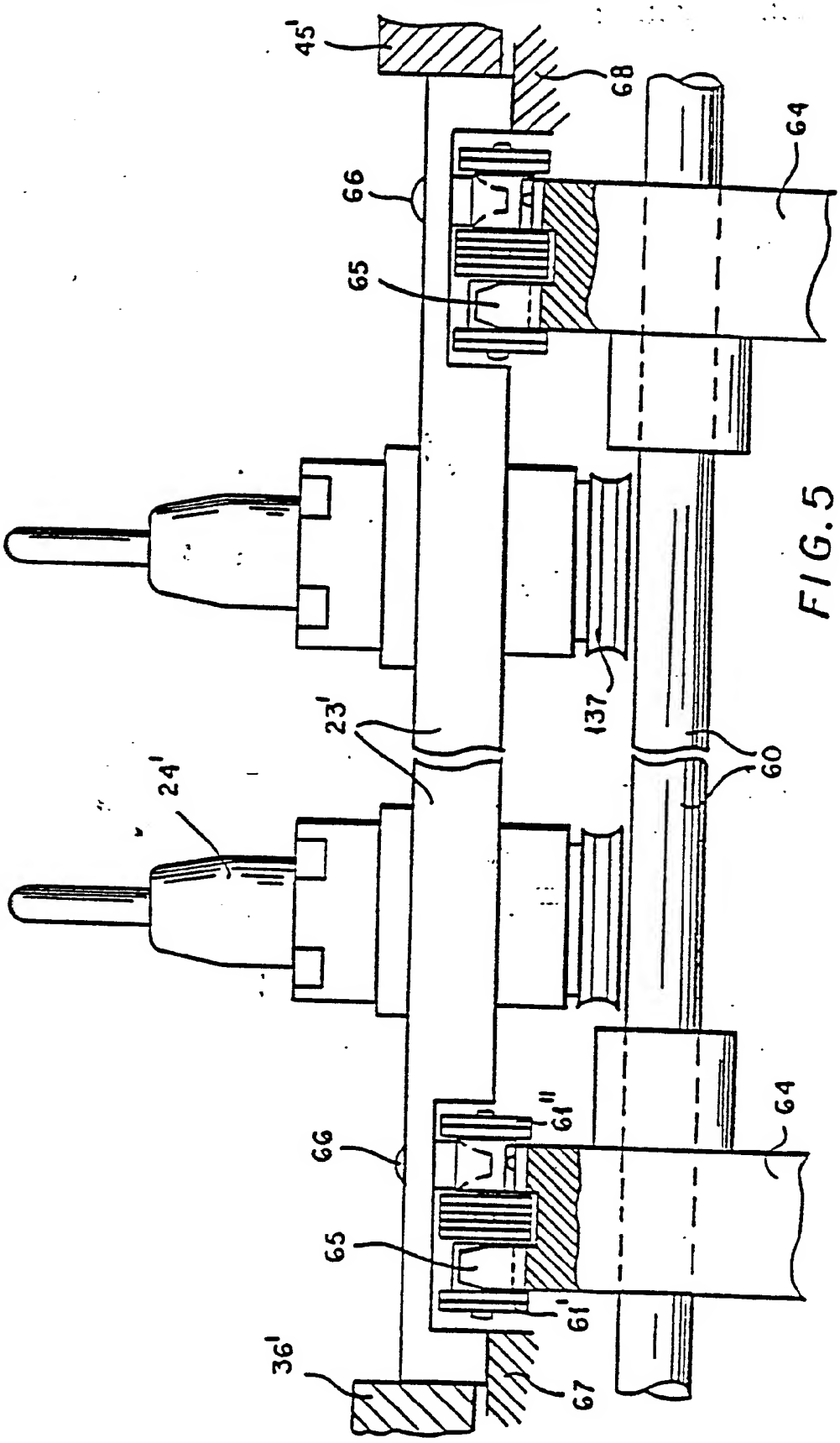

FIG.5

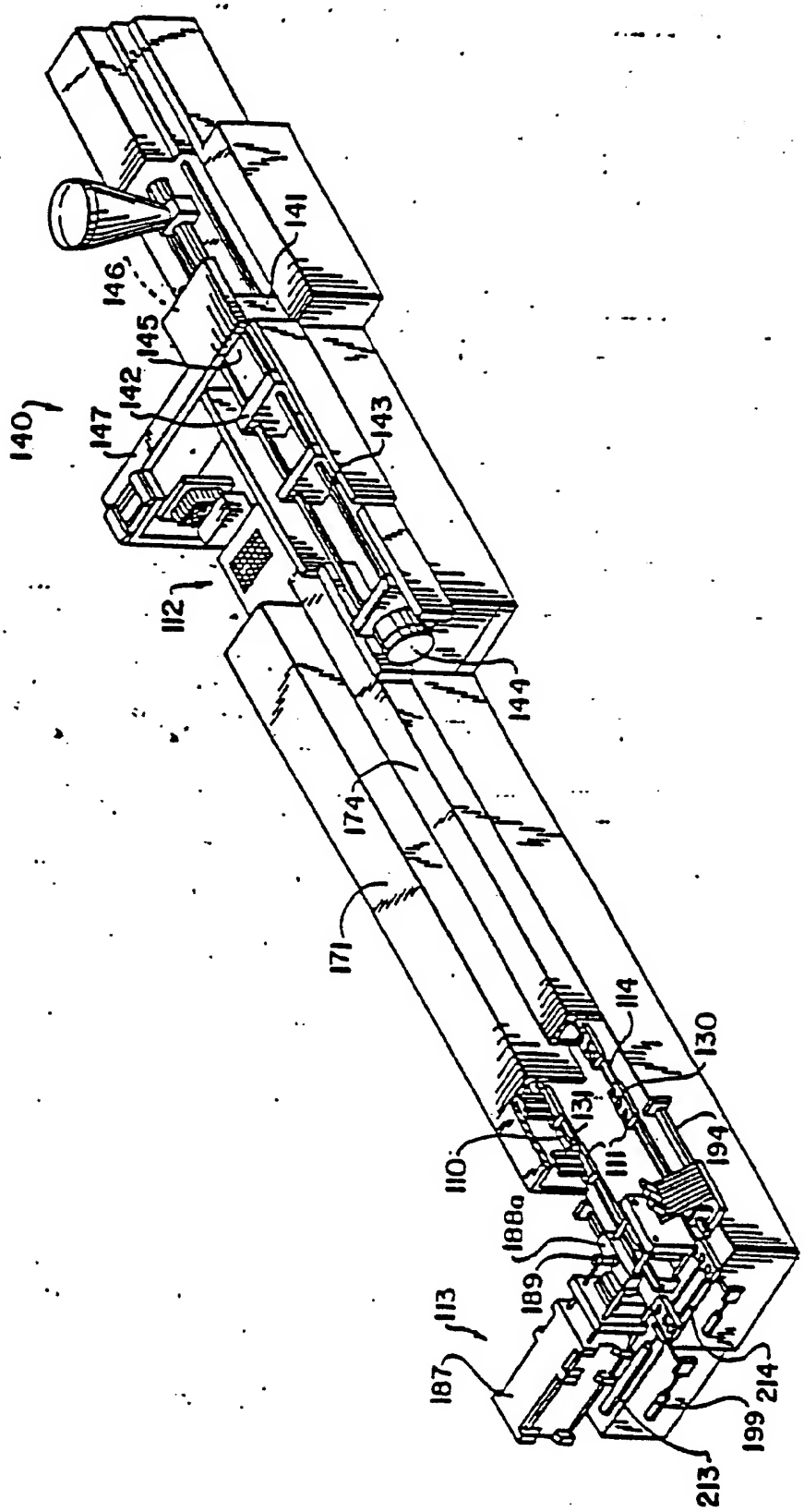
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FIG.6

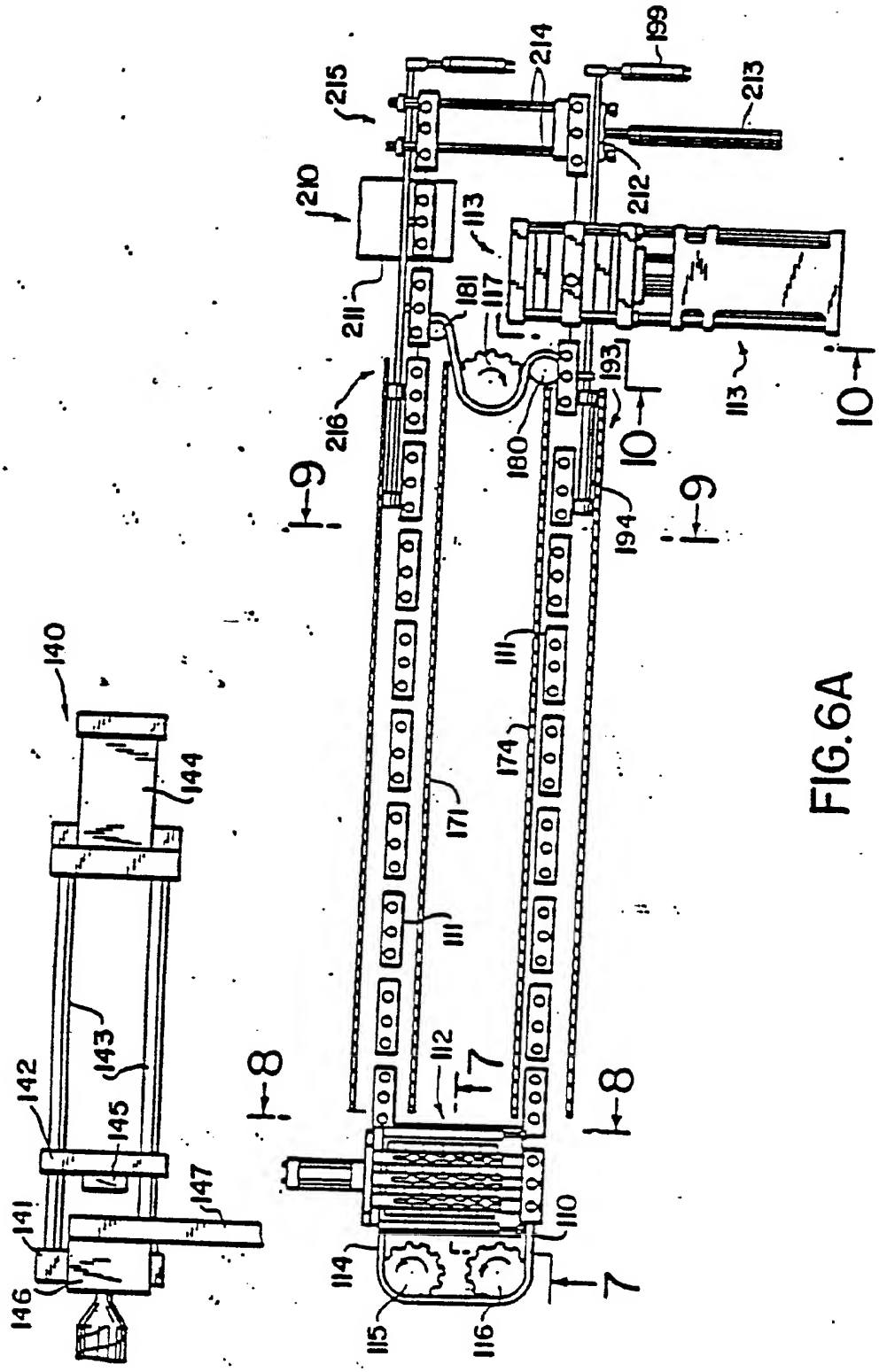
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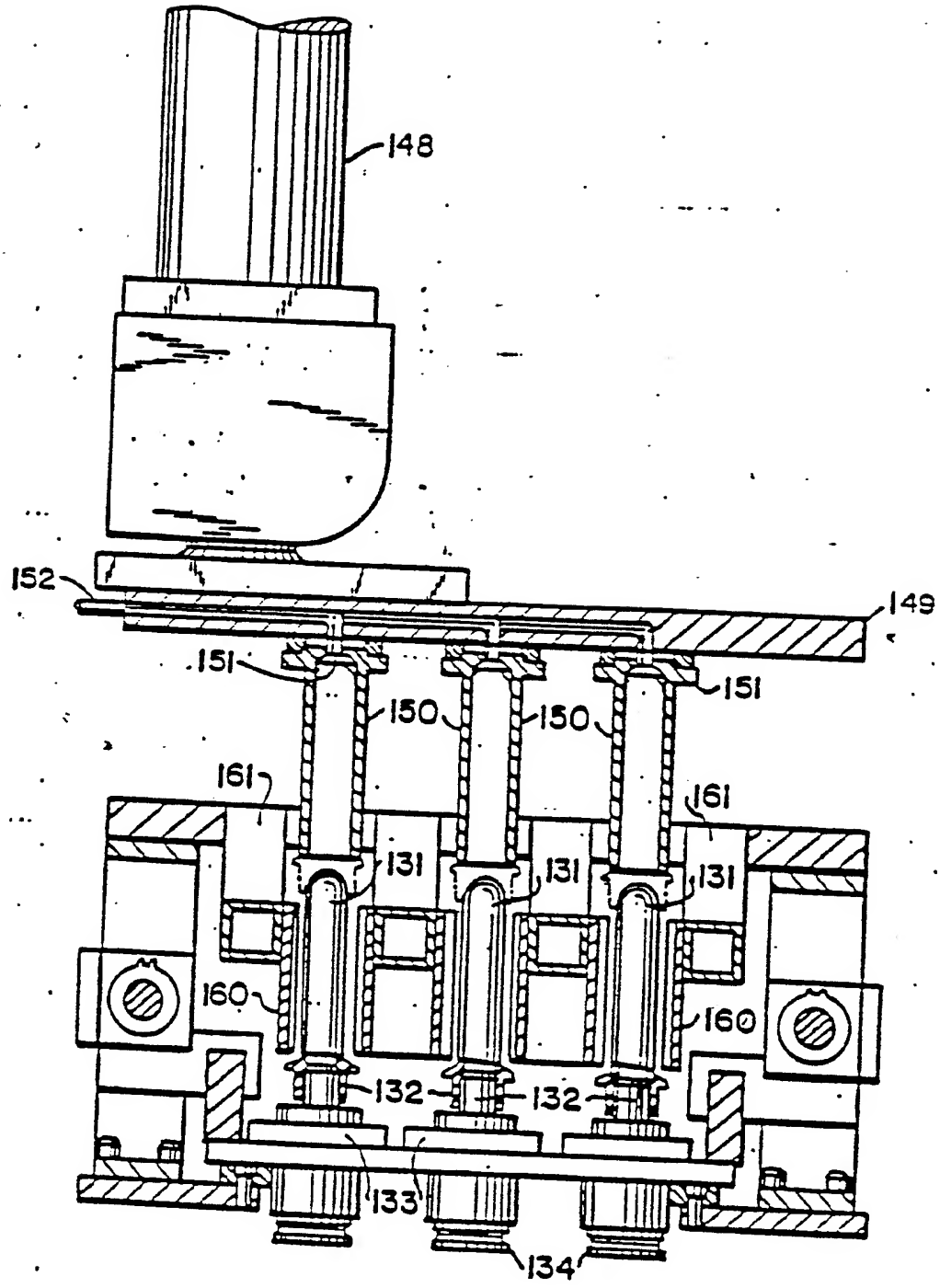
FIG.6A

FIG.7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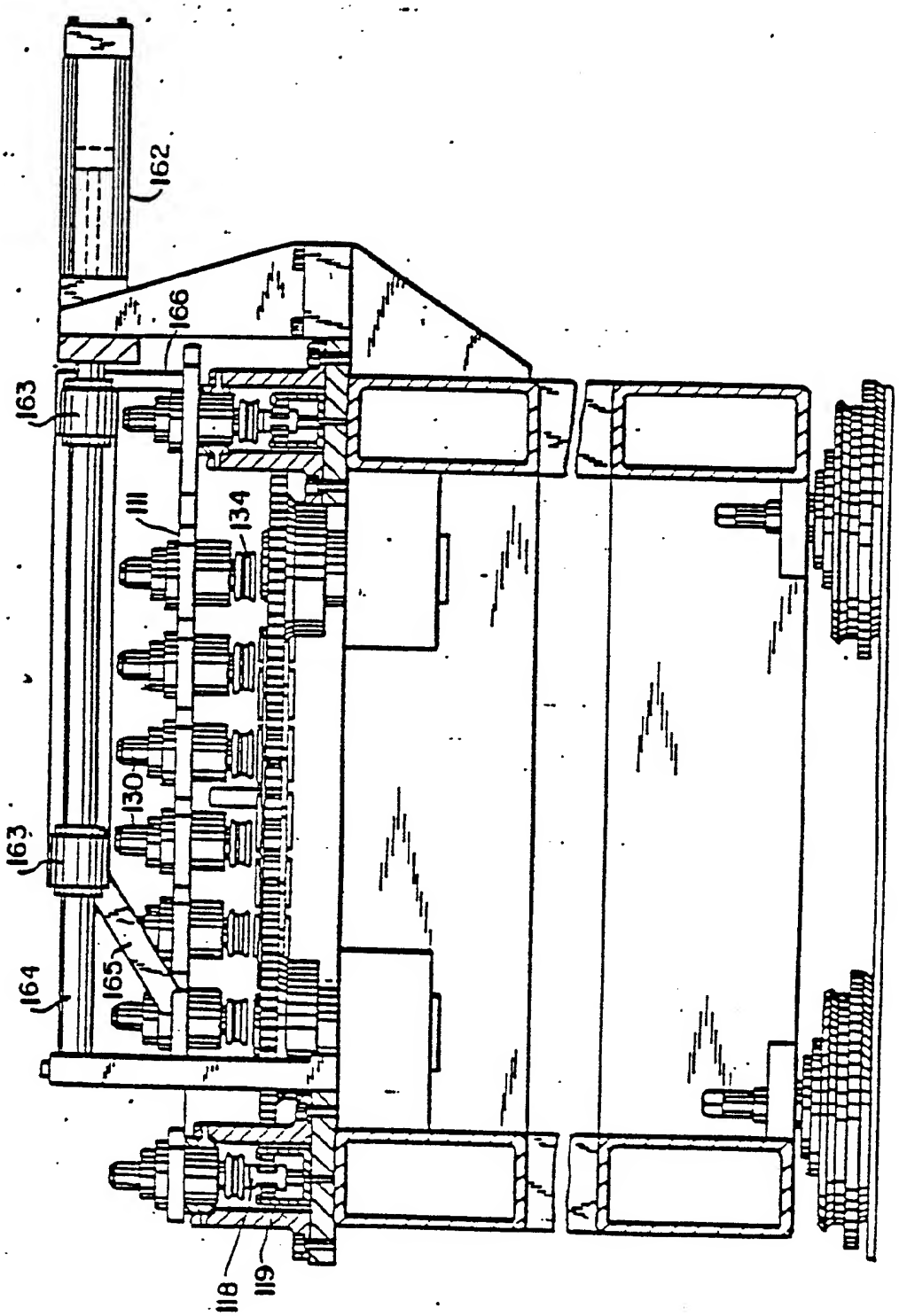
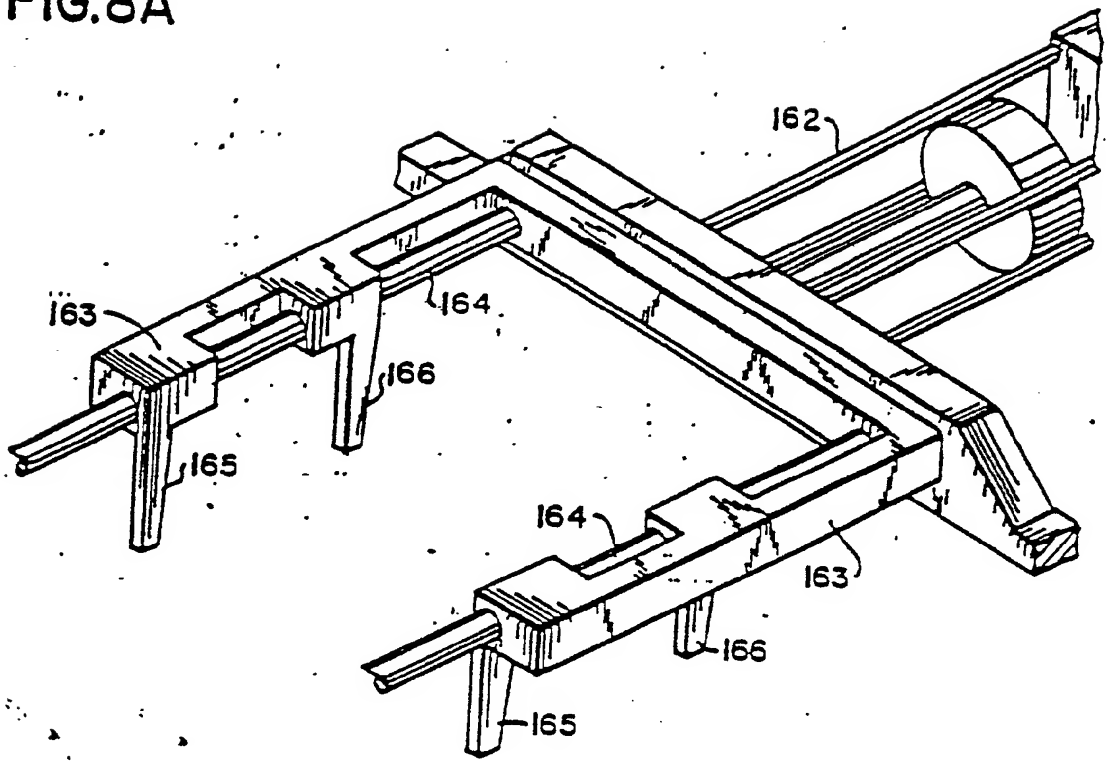


FIG.8

FIG.8A



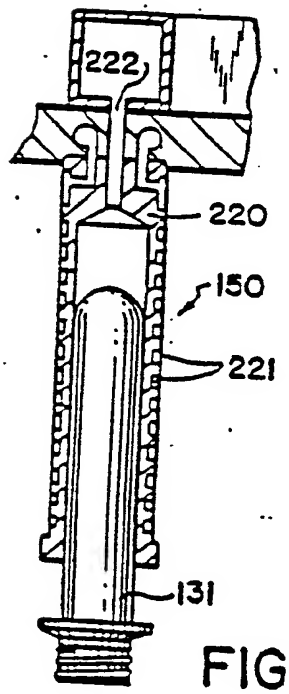


FIG.11

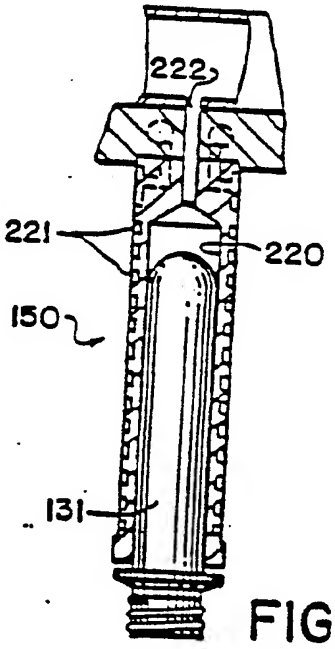


FIG.12

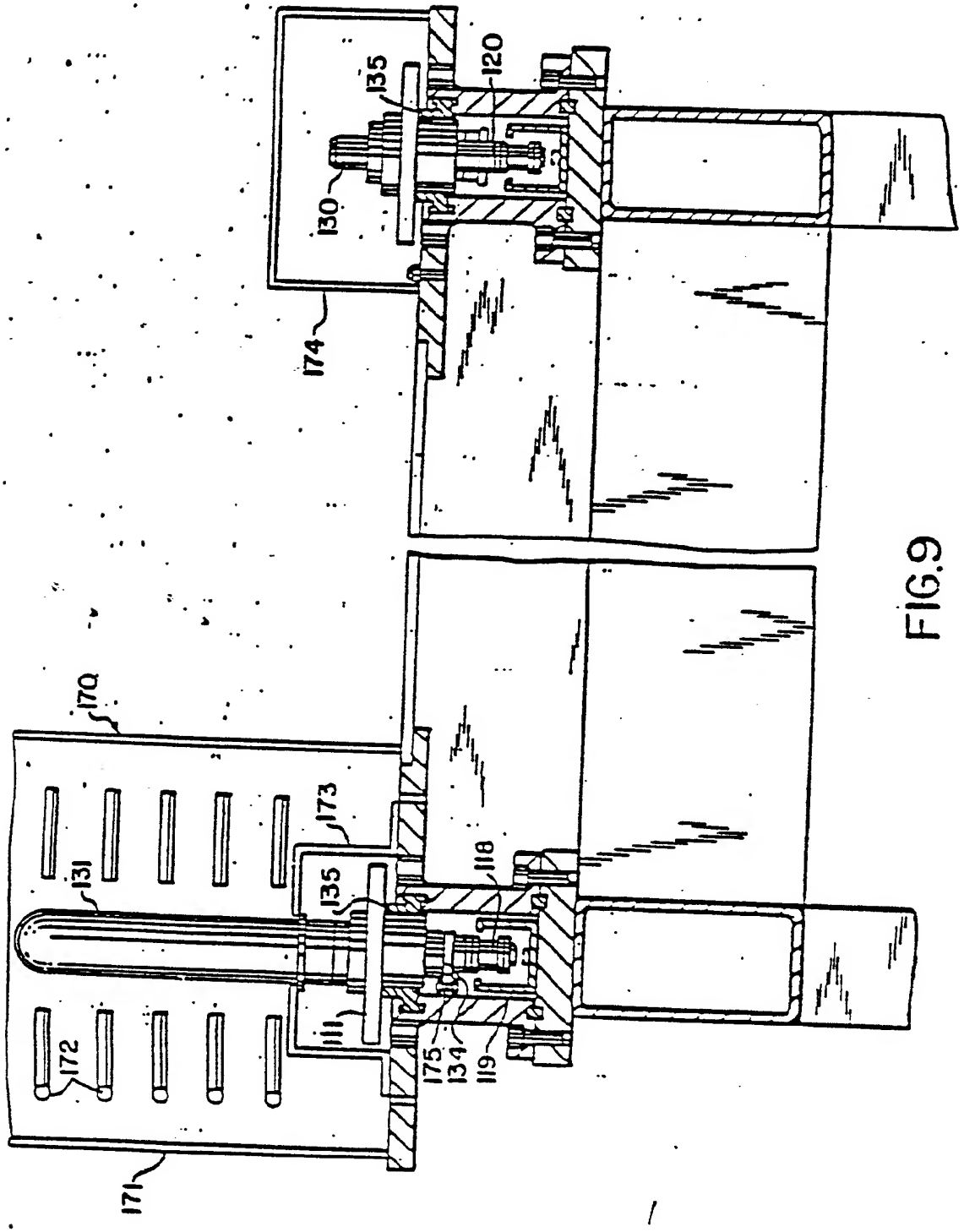


FIG.9

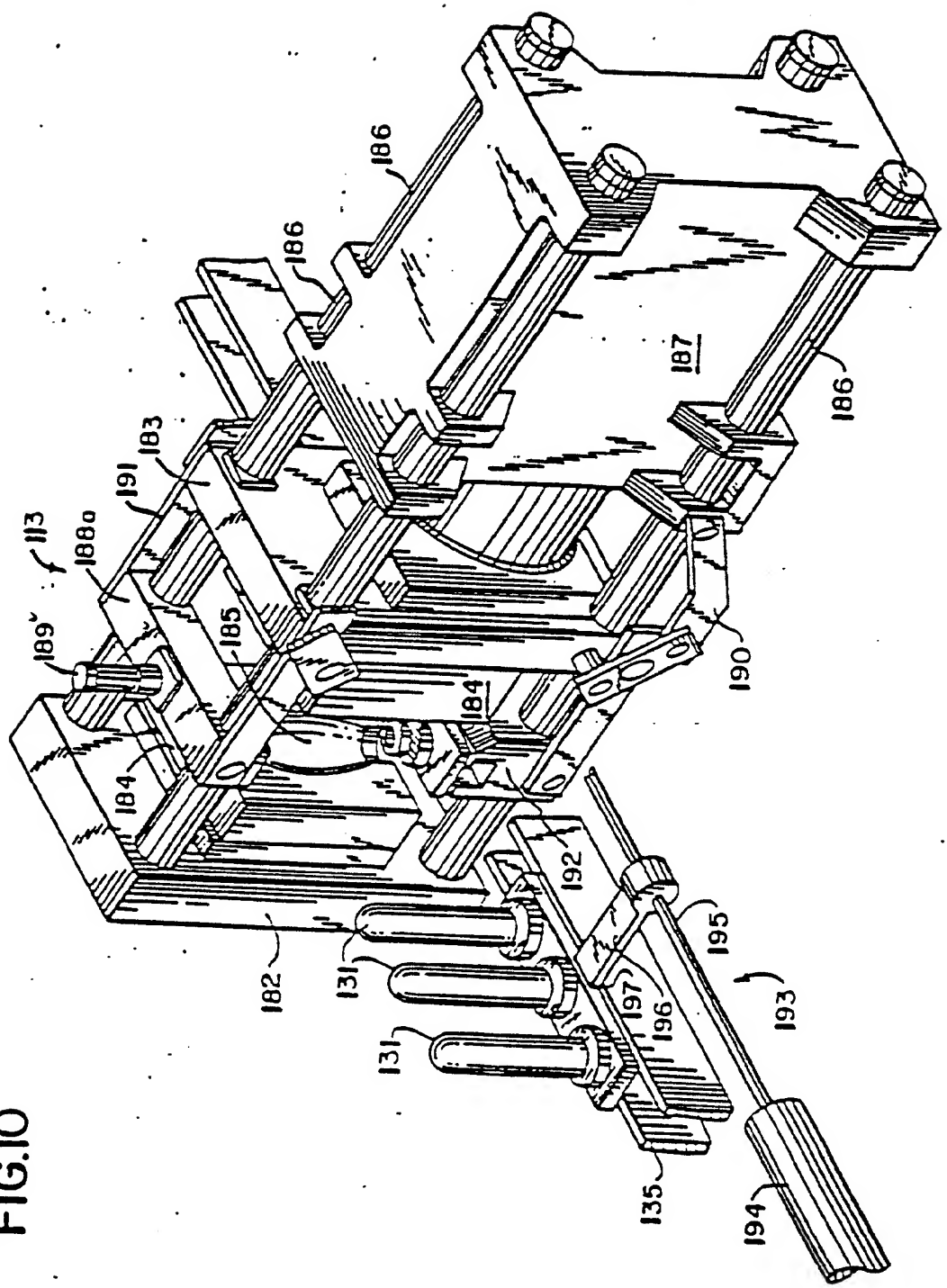

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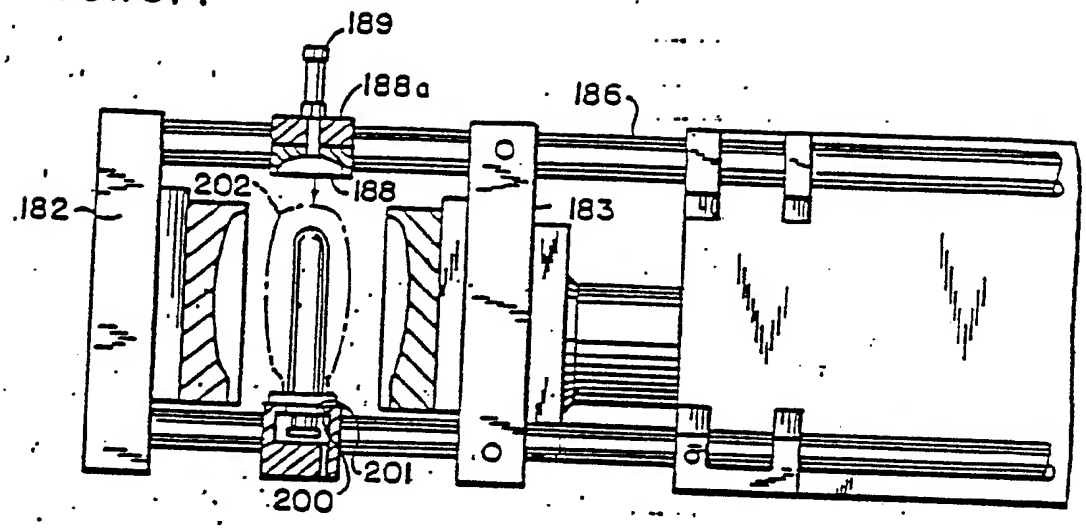
FIG.10

FIG.10A



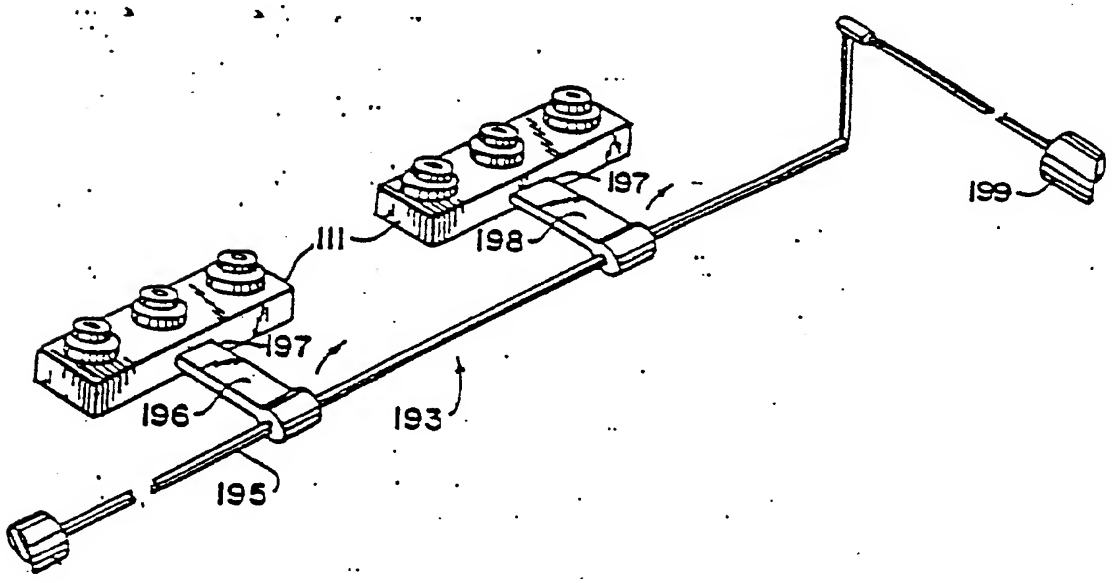


FIG.10B